

*California Environmental Protection Agency*

**AIR RESOURCES BOARD**

## **California Renewable Electricity Standard**

# **Public Workshop at the CPUC**

## **February 2, 2010**

## **9:00 A.M. to Noon**

# Agenda

- **Introductions & Update on Actions since last meeting**
  - **Mike Tollstrup**
- Summary of Comments on Draft Analyses
- Update on Technical Feasibility Analysis
  - GHG Benefits from Eligible Resources
  - Plausible Compliance Scenarios
- Update on Economic Analysis
- Update on Environmental Impact Analysis
- RES Regulatory Concepts
- Next Steps



# Agenda

- ✓ Introductions & Update on Actions since last meeting
- **Summary of Comments on Draft Analyses**
  - **Dave Mehl**
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# RES Analysis Approach Papers

- Technical Feasibility Analysis
  - Economic Analysis
  - Environmental Analysis
- 
- Released on December 8, 2009
  - Presented at December 14, 2009 workshop
  - Continuing to Accept comments





# **Technical Feasibility Analysis:**

## **Key Comments**

- No additional eligible technologies
- No exemption level
- Limit for REC-only compliance
- Required delivery
- Allow British Columbia “Run-of-River” hydro
- Analyze interaction with possible Federal RPS
- Analyze other State’s impact on REC
- Disagreement on possible load reduction



# **Economic Analysis: Key Comments**

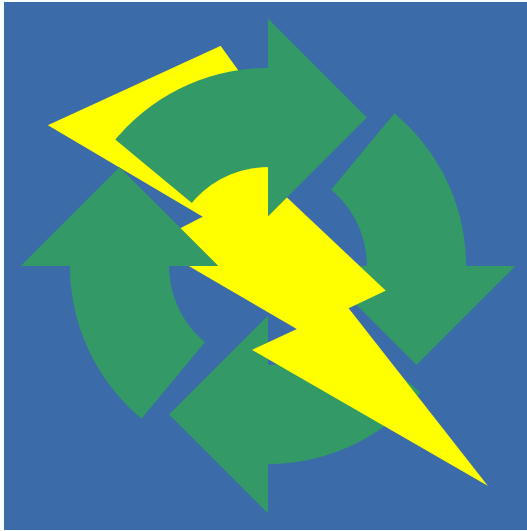
- Feed in tariff for wholesale DG
- Declining costs of solar technologies
- Analyze impact of other energy sector policies
- Expand ratepayers analysis beyond residential and small business
- Disagreement on PUC/RETI cost analysis



# **Environmental Analysis: Key Comments**

- No Comments Received





# **Questions:** **Summary of Comments**

Dave Mehl

Energy Section

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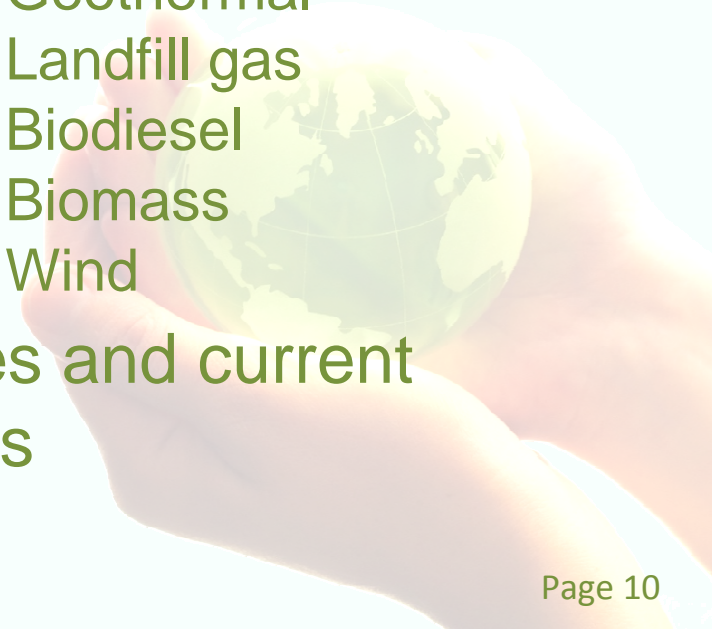
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- **Update on Technical Feasibility Analysis**
  - **GHG Benefits from Eligible Resources**
    - **Grant Chin**
      - Plausible Compliance Scenarios
  - Update on Economic Analysis
  - Update on Environmental Impact Analysis
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# RES Eligible Resources

- Goal: Determine the GHG benefit for eligible resources
- Eligible renewable resources include:
  - ▶ Incremental hydroelectric generation from efficiency improvements
  - ▶ Fuel cells using renewable fuels
  - ▶ Conduit hydroelectricity
  - ▶ Municipal solid waste
  - ▶ Small hydroelectric
  - ▶ Solar photovoltaic
  - ▶ Ocean thermal
  - ▶ Solar thermal
  - ▶ Tidal current
  - ▶ Digester gas
  - ▶ Ocean wave
  - ▶ Geothermal
  - ▶ Landfill gas
  - ▶ Biodiesel
  - ▶ Biomass
  - ▶ Wind
- Staff is evaluating other technologies and current limitations on RPS eligible resources



# RES Eligible Resource Evaluation

- Methodology for review
  - Determine the “net facility” GHG emissions from each resource
  - GHG emissions from operations support and maintenance were included
  - Incremental power displacement from grid



# RES Eligible Resource Evaluation

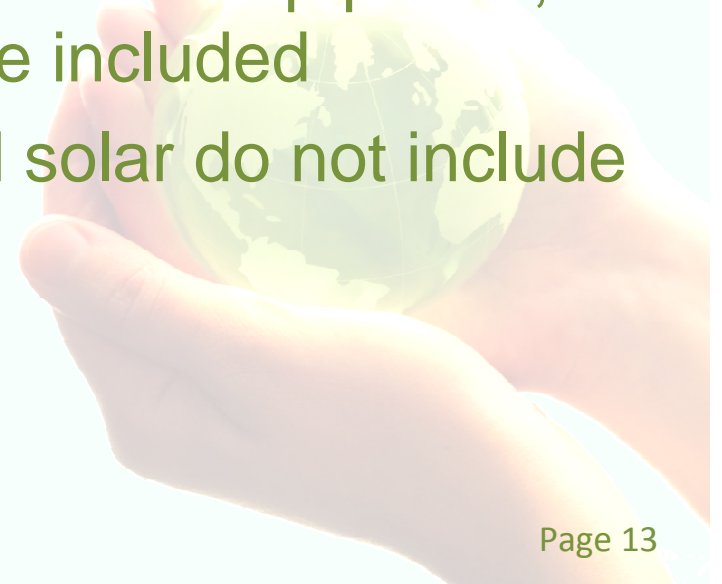
- Preliminary Results
  - GHG benefits are similar
  - Backup power not included with wind and solar
  - Exception is IC engines burning landfill/digester gas
  - GHG emissions from operations support and maintenance for most renewables were negligible except for biomass operations





# Backup Power

- Backup power may be needed for intermittent sources
- CAISO provides ancillary services for grid stability
  - Including providing backup power for all generating sources
- CAISO is studying the need for additional backup power for intermittent sources
- Should study show need for additional backup power, then backup power emissions will be included
- The preliminary results for wind and solar do not include backup power



# Landfill & Digester Gas

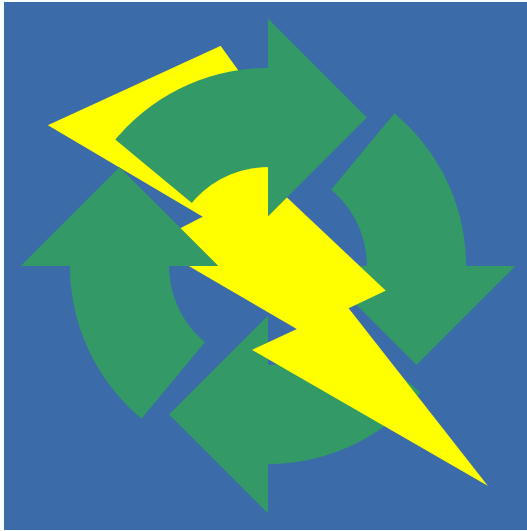
- California requires large landfills to use control devices for GHG emissions
- Lean burn IC engines are used at landfills to satisfy destruction goal and generate power
- Lean burn IC engines have a lower GHG destruction efficiency than a flare
- Lower destruction efficiency results in higher GHG emissions



# Next Steps

- Complete review of renewables
  - Evaluate landfill and digester GHG emissions for sources in California and within the WECC network
  - MSW combustion / conversion
- Evaluate renewables not eligible for the RPS
- Determine incremental power generation displaced by renewable generation





# **Questions: Technical Feasibility Analysis**

Grant Chin

Program Assistance Section

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# Agenda

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  - **Plausible Compliance Scenarios**
    - **Joseph Fischer**
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# Plausible Compliance Scenarios

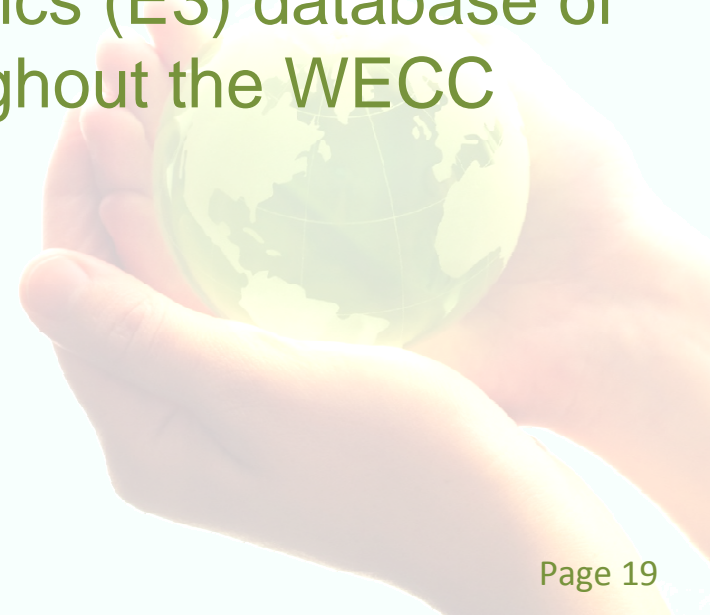
- Potential renewable energy mix examples to achieve a 33% RES
- Consider multiple inputs and outcomes over a wide range of possibilities
- Consider costs, energy origins, and environmental concerns within WECC
- Establish a means for evaluating technical, environmental, and economic impacts



# **Plausible Compliance Scenarios**

Scenarios developed by the energy agencies with projections based on:

- CPUC Energy Division Project Database (ED Database) of renewable projects in California
- Renewable Energy Transmission Initiative (RETI) database
- Energy and Environmental Economics (E3) database of renewable resource potential throughout the WECC



# **Plausible Compliance Scenario Inputs**

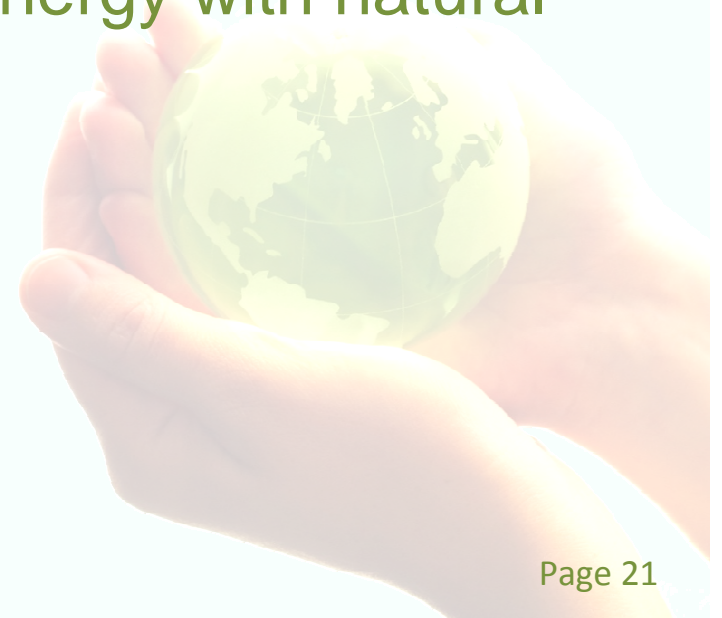
- All energy resources that are currently operational
- New energy resources currently expected to be constructed (in the application process)
- The 2009 IEPR Load Forecast projected for the year 2020
- Energy types and capacity factors





# Scenario Modeling Process

- Determine the energy resource gap needed to meet 2020 renewable targets
- Input existing constraints developed by RETI for each CREZ
- Identify associated technical, cost, and environmental concerns
- Balance fluctuations in renewable energy with natural gas power generation



# Plausible Compliance Scenarios

- Three plausible scenarios:
- High Net Short
  - Assumes no ARB Scoping Plan measures
- Medium Net Short
  - Energy Efficiency (12,100 GWh)
  - CHP (15,185 GWh)
- Low Net Short
  - Incorporates all ARB Scoping Plan measures
  - Energy Efficiency (24,200 GWh)
  - CHP (30,222 GWh)
  - Solar DG (2,030 GWh)



# Plausible Compliance Scenarios

2020 <u>HIGH</u> Net Short			
Type	Percentage	MW	GWh
Small Hydro	0.2%	40	177
Biogas	1.4%	279	2,077
Biomass	2.0%	429	3,003
Geothermal	7.4%	1,497	11,472
Solar PV	16%	3,165	6,764
Solar Thermal	32%	6,513	16,087
Wind	41%	8,338	24,547
Total Net Short	100%	20,261	64,127

# Plausible Compliance Scenarios

2020 <u>MEDIUM</u> Net Short			
Type	Percentage	MW	GWh
Small Hydro	0.2%	40	177
Biogas	1.5%	279	2,077
Biomass	1.7%	328	2,297
Geothermal	7.5%	1,395	10,689
Solar PV	16%	2,954	6,314
Solar Thermal	35%	6,405	15,824
Wind	39%	7,091	20,741
Total Net Short	100%	18,493	58,118

# Plausible Compliance Scenarios

2020 <u>LOW</u> Net Short			
Type	Percentage	MW	GWh
Small Hydro	0.2%	40	177
Biogas	0.2%	30	223
Biomass	2.0%	328	2,297
Geothermal	7.8%	1,299	9,963
Solar PV	17%	2,867	6,127
Solar Thermal	30%	4,907	11,984
Wind	43%	7,091	20,741
Total Net Short	100%	16,561	51,511

# Renewable Energy Credits

- ARB and energy agencies investigating renewable energy credit (REC) impacts
- ARB and E3 developing a scope of work for REC analysis of the 33% RES scenarios
- Will add RECs to the renewable energy mix



# **Renewable Energy Credits**

- Addition of RECs may change plausible scenario energy mixes
- Results may influence transmission line assumptions
- Results may impact the costs of the plausible scenarios



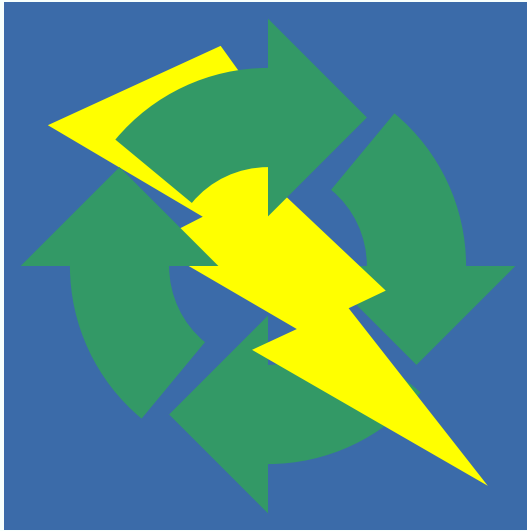
# Plausible Compliance Scenario

## Contract Work

- Contract work with E3 to conduct analyses:
  - Update scenario cost and related information
  - Verify 20% RPS scenario costs
  - Verify 33% RES plausible scenario costs
  - Run 33% RES scenarios with RECs
- Provide analyses of incremental impacts between 20% RPS and 33% RES scenarios
- Work expected to be completed in the first quarter of 2010







# **Questions: Plausible Compliance Scenarios**

Joseph Fischer

Strategy Evaluation Section

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  - **Janet Schlosser**
    - Update on Environmental Impact Analysis
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# Economic Analysis

- Assess impacts on California business creation, expansion, or elimination as a result of the proposed 33% Renewable Electricity Standard By ARB.
- Assess whether the regulation will create or eliminate jobs
- Assess impacts on affected individuals in California
- Assess impacts on small businesses
- Assess impacts on California business competitiveness with other states
- Assess any disproportionate impacts on low-income communities



# RPS Calculator Scenarios

- Currently working with E3, CPUC, CEC, and CA ISO to fully define each scenario
  - 20% RPS Baseline
  - 33% RES Scenarios
  - 33% RES Scenarios with RECs
- Use RPS Calculator to determine resource mix and costs associated with each RES Scenario relative to the 20% RPS baseline



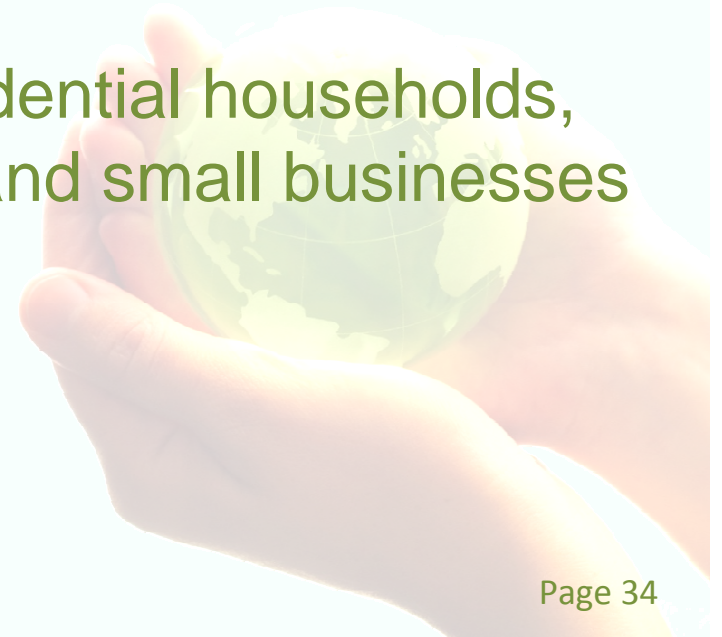
# RPS Calculator Cost Output

- Capital cost of constructing energy resources
- Energy market value of resource output
- Intermittent energy integration cost
- Cost of transmission line infrastructure
- Potential costs associated with tradable renewable energy credits, if allowed within the scope of the regulation
- Potential cost or revenue impacts from the auction of CO2 allowances by State or Federal governments



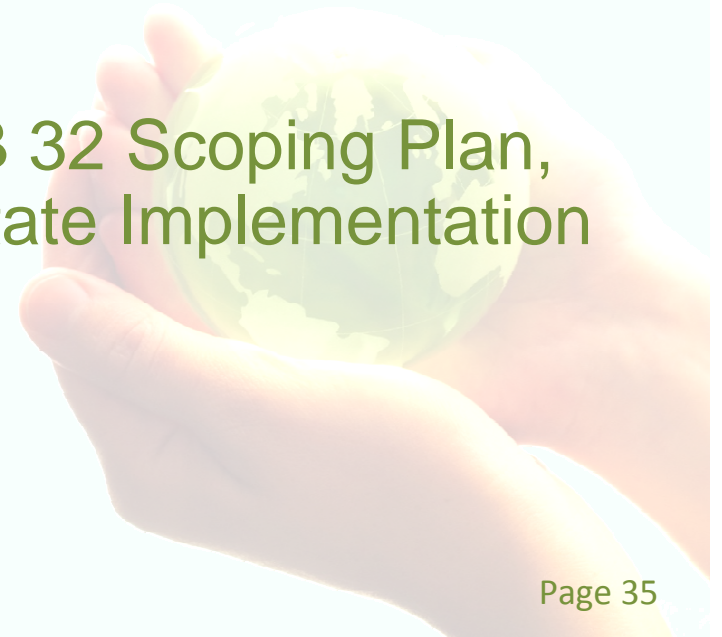
# Next Steps

- Translate cost output from RPS Calculator into Environmental Dynamic Revenue Analysis Model (EDRAM) inputs
- Break down estimates money invested in new renewable generation as a result of RES and attribute to economic industry sectors based on renewable resource
- Use as inputs for EDRAM
- Use to estimate bill impacts on residential households, low income residential customers, and small businesses



# EDRAM

- Computable General Equilibrium Model of the entire California Economy.
- Built by UCB in collaboration with Department of Finance and the Air Resources Board.
- Model Code and Data available for public use.
- Current version is 120 Industrial Sector Version in collaboration with ARB
- Used in past analyses including: AB 32 Scoping Plan, Pavley Clean Car Standards, the State Implementation Plan, and others



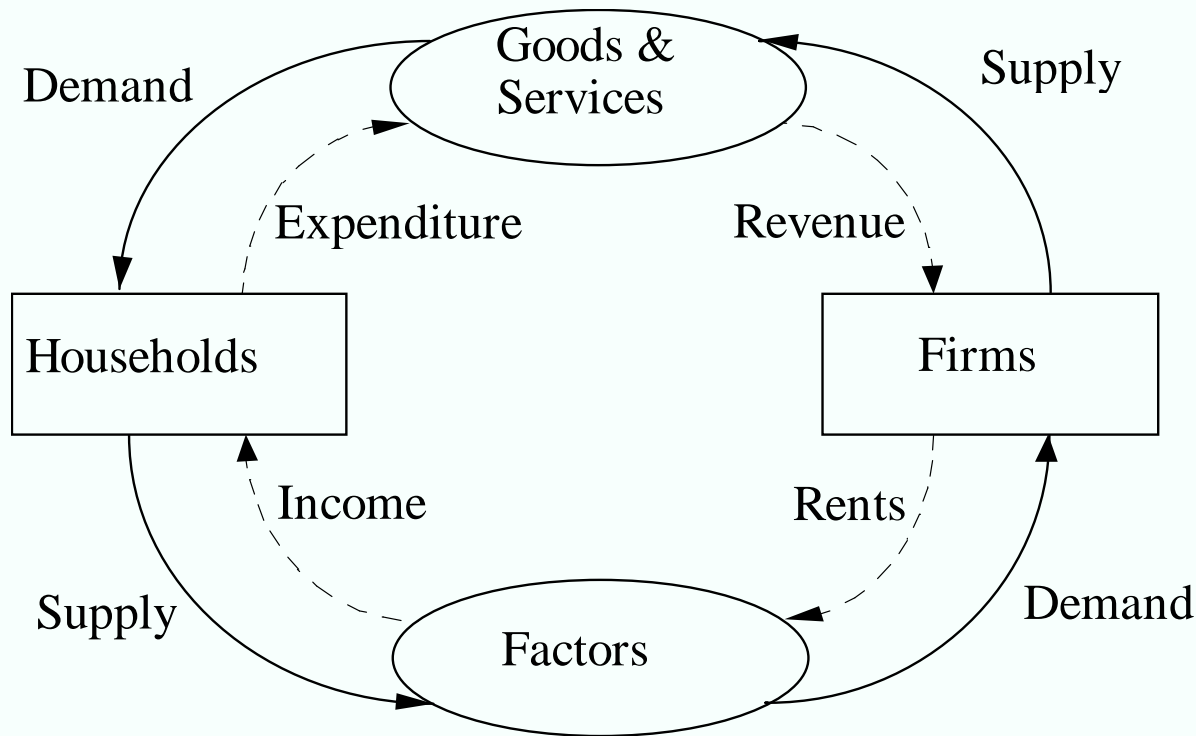
# **EDRAM Impact Results**

- Business creation, expansion, or elimination
- Job creation or elimination
- Small business impacts
- Competitiveness of California business





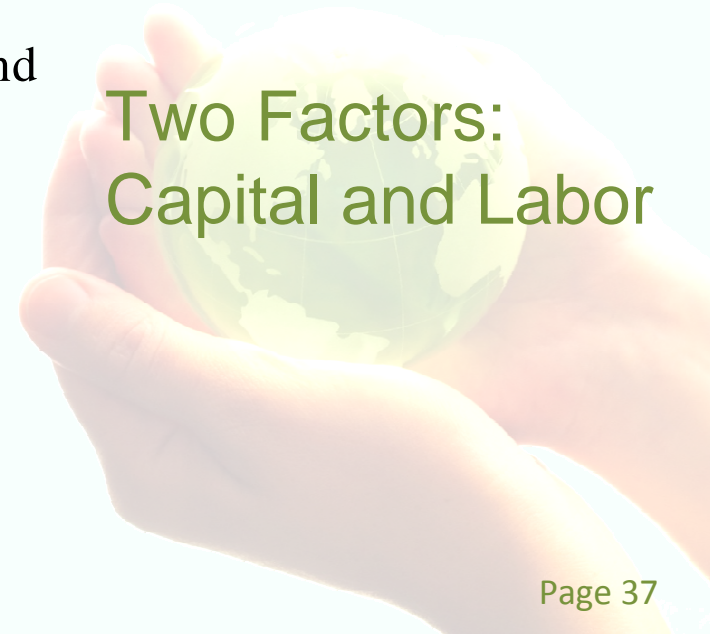
# Goods and Services



Source: Berck, Golan, and Smith, 1996.

120 different  
goods and  
services and  
120 types of  
firms

Two Factors:  
Capital and Labor



# Model Inputs

- Additional or avoided expenditures on sectors in a future year (vs. BAU base case) as a result of policies
  - Costs of the Strategies: Allocated to individual affected industrial sectors
  - Savings of the Strategies: allocated to consumers or affected sectors
- Data are in billions of 2008 dollars



# Model Outputs

- EDRAM generates macro indicators at the state level:
  - Output
  - Gross State Product (GSP)
  - State Personal Income (SPI)
  - Employment
- Generates results specifically for each of closely affected sectors

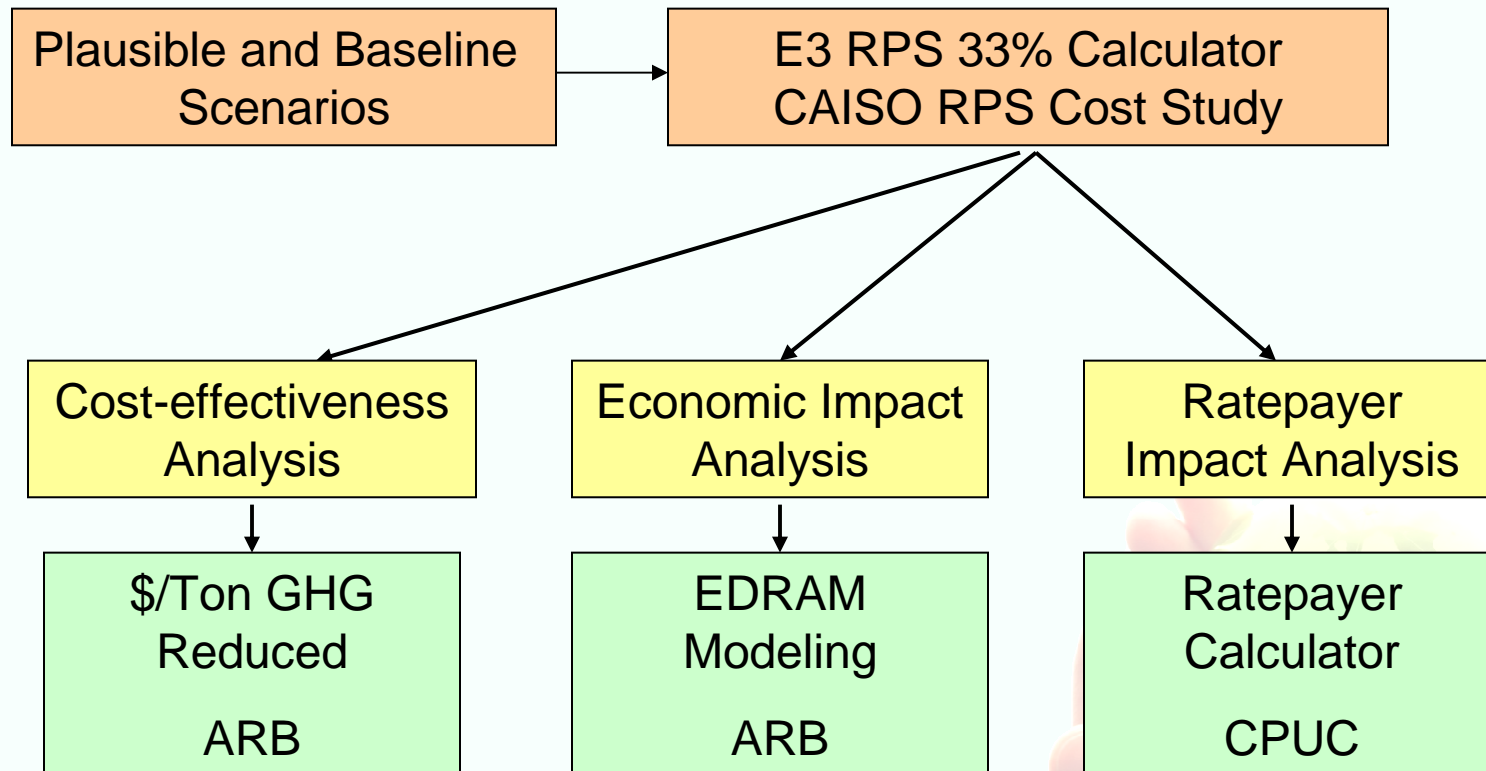


# EDRAM Summary

- EDRAM is a California model tuned to the California economy and law.
- EDRAM can generate macroeconomic metrics for the state and individual industrial sectors.
- Economic modeling could examine impacts of various RES scenarios on California economy.

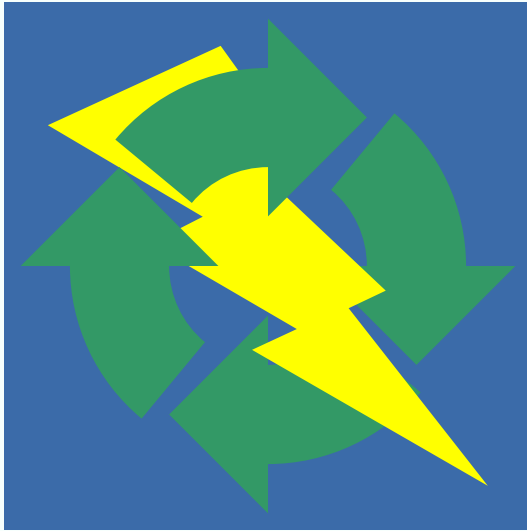


# Economic Analysis Summary



# Analysis Timeline

Task	Deliverable	Date
Complete 33% RPS Calculator updates	33% RPS Calculator ready for RES scenario modeling	March
Cost Analysis	Incremental cost results from 33% RPS Calculator	March
Economic Impact Analysis	Results from E-DRAM modeling	April
Staff Report	All results and methodology for economic analysis of RES	June



## **Questions:** **Economic Analysis**

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# Status of Environmental Impacts Analysis

- Developed preliminary estimates of air quality impacts
- Submitted contract proposal for analysis of impacts to DGS
- Working with DGS on the RFQ for a consultant contract



# Scope of Proposed Contract

- Evaluate the environmental impacts of a 33% RES in 2020
- Focus on land, water, biological, cultural, and visual impacts
- Consider alternatives to 33% RES proposal
  - ✓ No project
  - ✓ No threshold for excluding small load serving entities



# **Scope of Proposed Contract (Cont)**

- Including the following renewable resources:
  - ✓ Wind
  - ✓ Solar Thermal
  - ✓ Solar PV
  - ✓ Geothermal
  - ✓ Solid-fuel Biomass
  - ✓ Landfill/Digester Gas Power Generation
  - ✓ Small Hydro
- Comparing criteria pollutant emissions from renewable resources to the 2020 average grid emissions



# Scope of Proposed Contract (Cont)

- Evaluating environmental impacts to:
  - ✓ Air
  - ✓ Land
  - ✓ Water
  - ✓ Biological
  - ✓ Cultural
  - ✓ Visual
- Assessing the impacts to environmental justice communities



# Environmental Justice

- Considering impacts of existing and new power generating facilities on EJ communities
- Evaluating compliance scenarios to ensure the proposed RES regulation does not adversely impact EJ communities
- Analyzing cumulative impacts from criteria and toxic pollutants



# Potential Air Quality Benefits from Wind Generation

## Criteria Pollutant Emissions (kg/MWh)

	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Operating Emissions	0	0	0	0	0	0
Avoided Emissions	0.009	0.067	0.006	0.136	0.039	0.039

Source: ARB

# Other Potential Environmental Impacts

- Aesthetics
  - ✓ Visual impacts may be difficult to mitigate
- Biological Resources
  - ✓ Hazard to birds and bats
- Land Use and Planning
  - ✓ Requires large land areas



# Potential Air Quality Benefits from Solar Thermal Generation

## Criteria Pollutant Emissions (kg/MWh) (Parabolic Trough)

	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Operating Emissions	0.007	0.004	0.000	0.003	0.014	0.006
Avoided Emissions	0.002	0.063	0.006	0.133	0.025	0.033

Source: ARB and CEC



# Potential Air Quality Benefits from Solar Thermal Generation

Solar Thermal

## Criteria Pollutant Emissions (kg/MWh) (Power Tower)

	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Operating Emissions	0.004	0.013	0.002	0.015	0.019	0.008
Avoided Emissions	0.005	0.054	0.004	0.121	0.020	0.031

Sources: ARB and CEC

# Other Potential Environmental Impacts

- Aesthetics
  - ✓ Visual impacts may be difficult to mitigate
- Biological Resources
  - ✓ Can affect local habitats and migratory species
- Land Use and Planning
  - ✓ Requires 5-10 acres per MW
- Water Quality
  - ✓ 500-800 gal/MWh of water for wet-cooling
  - ✓ 20-40 gal/MWh of water for mirror washing

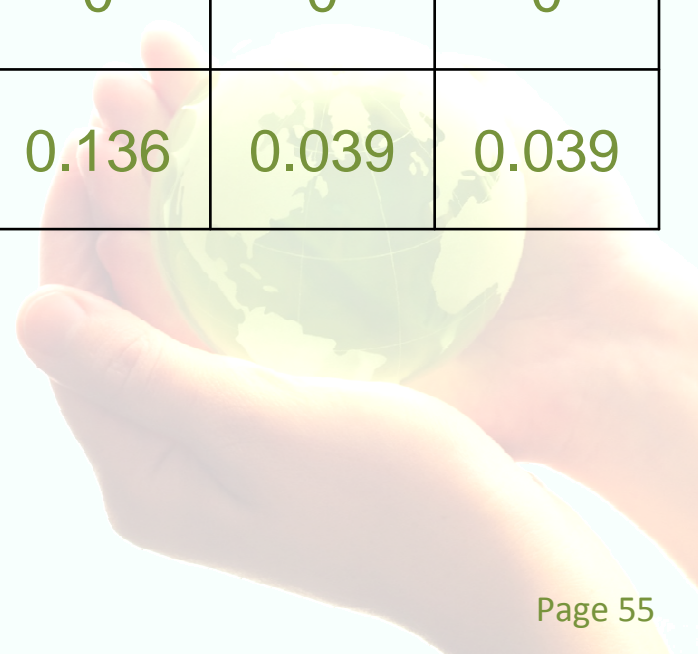


# Potential Air Quality Benefits from Photovoltaic Generation

## Criteria Pollutant Emissions (kg/MWh)

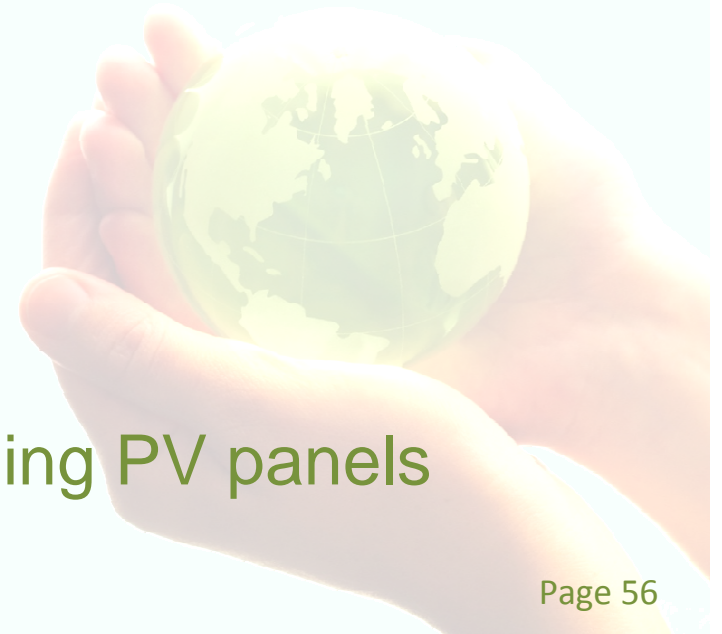
	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Operating Emissions	0	0	0	0	0	0
Avoided Emissions	0.009	0.067	0.006	0.136	0.039	0.039

Source: ARB



# Other Potential Environmental Impacts

- Aesthetics
  - ✓ Visual impacts may be difficult to mitigate
- Biological Resources
  - ✓ Can affect local habitats and migratory species
- Land Use and Planning
  - ✓ Requires 5-10 acres per MW
- Water Quality
  - ✓ 20-40 gal/MWh of water for washing PV panels



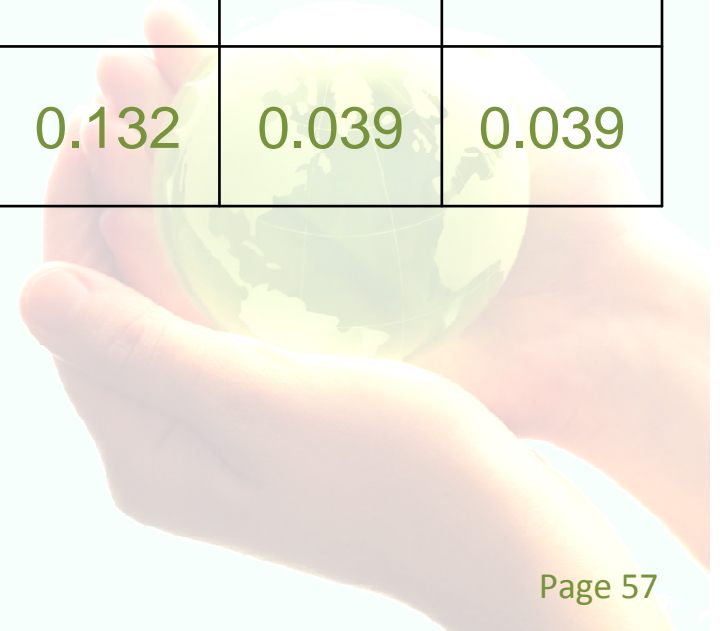
# Potential Air Quality Impacts from Geothermal Generation

## Criteria Pollutant Emissions (kg/MWh)

	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Operating Emissions <sup>1</sup>	0.001	0.002	0.015	0.004	0	0
Change in Emissions	0.008	0.065	-0.009	0.132	0.039	0.039

Source: ARB and AECOM

1. Flash-steam technology



# Other Potential Environmental Impacts

- Geology and Soils
  - ✓ Induced seismicity and landslides are rare occurrence in hydrothermal operations
- Land Use and Planning
  - ✓ Footprint is a function of plant capacity and hydrothermal quality
  - ✓ Smaller footprint than solar thermal or solar PV
- Noise
  - ✓ Comparable to a major freeway
- Water Quality
  - ✓ Boron and arsenic from well drilling, simulation, and production



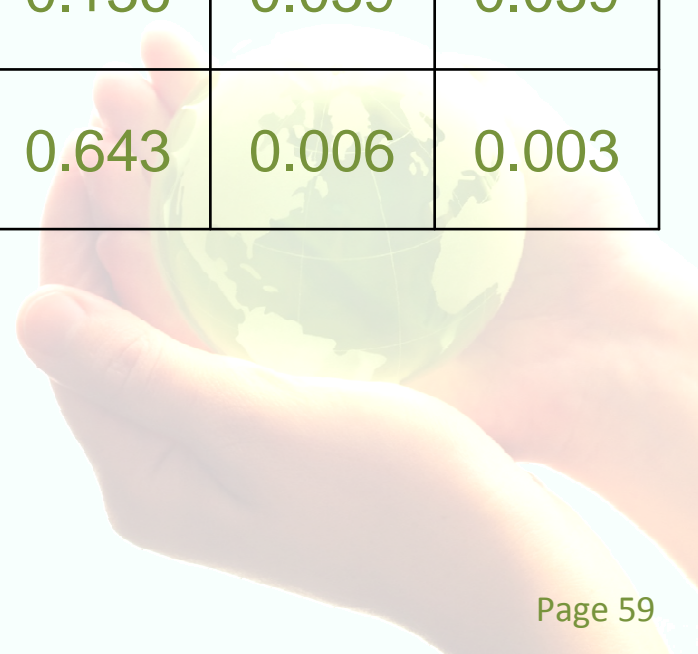
# Potential Air Quality Impacts from Solid-Fuel Biomass Generation

## Criteria Pollutant Emissions (kg/MWh)

	ROG	NOx	SOx	CO	PM10	PM2.5
Operating Emissions*	0.009	0.217	0.040	0.779	0.045	0.042
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Increase in Emissions	0	0.150	0.035	0.643	0.006	0.003

Source: ARB

\*Combustion technology, including MSW



# Potential Air Quality Impacts from Solid-Fuel Biomass Transportation

## Diesel Truck Emission Factors (g/mi)

	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Fleet Average	0.52	7.86	0.18	3.32	0.24	0.22

Source: ARB





# Other Potential Environmental Impacts

- Geology and Soils
  - ✓ Potential impact when biomass comes from tree-farming use
  - ✓ Biochar use as soil amendment may have positive effect
- Hazards and Hazardous Materials
  - ✓ Increased truck usage may lead to higher diesel truck emissions
- Noise
  - ✓ Potential impact from truck traffic and power plant operation
- Population and Housing
  - ✓ Potential impact from truck traffic



# Potential Air Quality Impacts from Landfill / Digester Gas Generation

## Criteria Pollutant Emissions (kg/MWh)

	ROG	NOx	SOx	CO	PM10	PM2.5
Operating Emissions	0.025	0.220	0.026	0.571	0.018	0.018
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Change in Emissions	0.016	0.153	0.020	0.435	-0.021	-0.021

Sources: ARB and CEC

# Other Potential Environmental Impacts

- Biological Resources
  - ✓ Animal disposal and animal health concerns associated with emerging animal diseases
- Hazards and Hazardous Materials
  - ✓ Handling condensate from dewatering process
- Noise
  - ✓ From gas extraction process
- Population and Housing
  - ✓ Odor from organic materials
  - ✓ Dairy digesters reduce dairy manure odor
- Water Quality
  - ✓ Leachate may contaminate groundwater

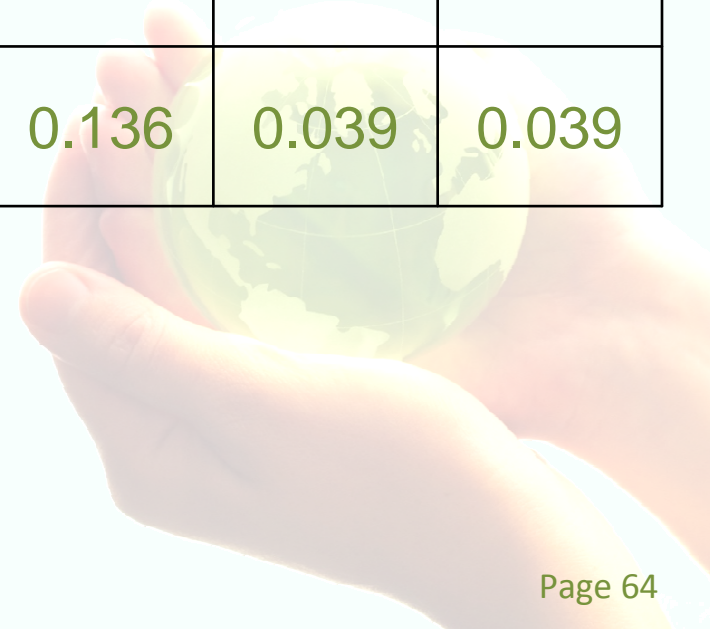


# Potential Air Quality Benefits from Small Hydroelectric Generation

## Criteria Pollutant Emissions (kg/MWh)

	ROG	NOx	SOx	CO	PM10	PM2.5
2020 Avg. Grid Emissions	0.009	0.067	0.006	0.136	0.039	0.039
Operating Emissions	0	0	0	0	0	0
Avoided Emissions	0.009	0.067	0.006	0.136	0.039	0.039

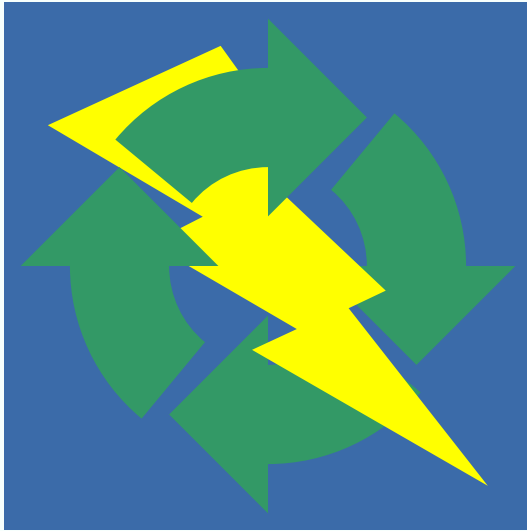
Source: ARB and CEC



# Other Potential Environmental Impacts

- Aesthetics
  - ✓ Visual impacts
- Biological Resources
  - ✓ Impacts on diverse habitat and ecosystems
- Transportation/Traffic
  - ✓ Need to construct roads
- Water Quality
  - ✓ Impacts on water flow





# Points of Contact

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  - **Gary Collord**
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# Applicability

- Applies to electrical corporations, electricity service providers, community choice aggregators, electrical cooperatives, & local publicly owned electric utilities
- Still evaluating DWR and WAPA



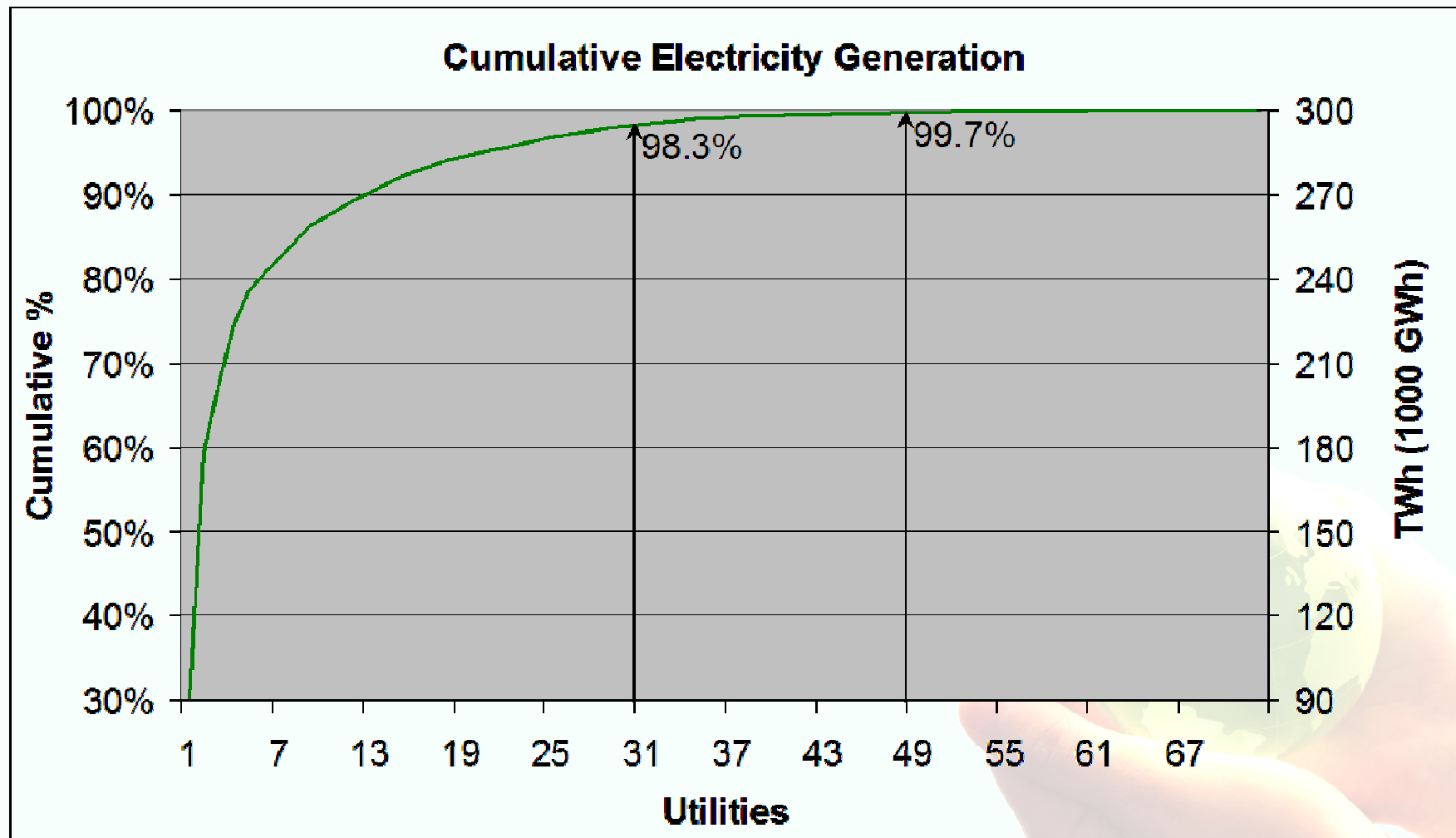


# Exemption Threshold

- Still evaluating appropriate threshold for smaller utilities.
- For example:
  - 500 GWh captures 31 utilities or 98.3% of combined utility load
  - 100 GWh captures 49 utilities or 99.7% of combined utility load
- Significance factors being analyzed include significance of load served, administrative burden of compliance, and cost impacts to utilities and ratepayers



# Exemption Threshold



# Compliance Metric

- Based on procured generation and megawatt hours of retail sales—adheres to RPS
- Potential need for alternate metric for DWR and WAPA



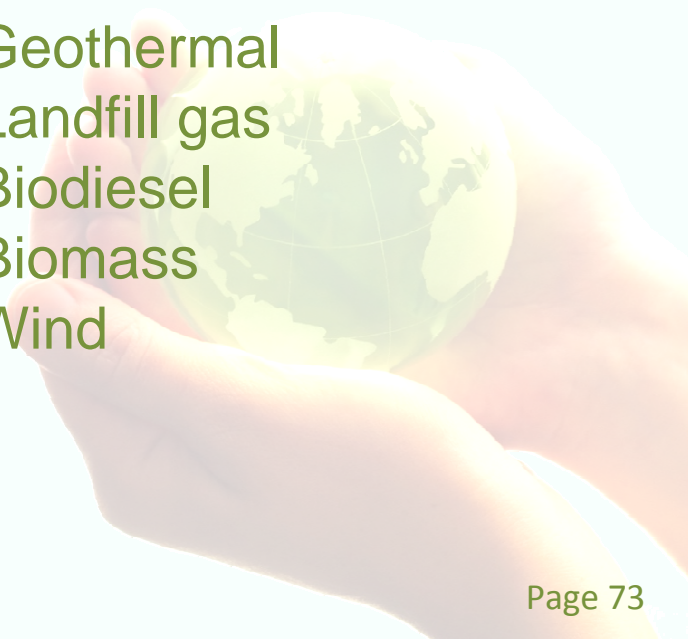
# Compliance Intervals

- Same intervals for POU's and IOUs
  - 20% in calendar year 2013
  - 24% in calendar year 2016
  - 28% in calendar year 2018
  - 33% in calendar year 2020



# Eligible Resources

- No additions/modifications to RPS
- Reflect any RPS program updates prior to adoption
  - ▶ Incremental hydroelectric generation from efficiency improvements
  - ▶ Fuel cells using renewable fuels
  - ▶ Conduit hydroelectricity
  - ▶ Municipal solid waste
  - ▶ Small hydroelectric
  - ▶ Solar photovoltaic
  - ▶ Ocean thermal
  - ▶ Solar thermal
  - ▶ Tidal current
  - ▶ Digester gas
  - ▶ Ocean wave
  - ▶ Geothermal
  - ▶ Landfill gas
  - ▶ Biodiesel
  - ▶ Biomass
  - ▶ Wind



# Uncertified Resources

- POU's may continue limited use under RES:
  - Demonstrate prior use for RPS goals
  - RES eligibility expires with procurement contract or with expansion or added investments to owned resources
  - Expired resource must be replaced with a certified resource



# Renewable Energy Credits

- Bundled and unbundled REC options proposed
- Bundled RECs must comply with RPS delivery requirements and other provisions
- Unbundled REC option has no delivery requirement
- No limit on use of bundled or unbundled RECs



# Tradable Renewable Energy Credits

- ARB evaluating trading provisions in CPUC proposed decision
- ARB still evaluating potential REC trading provisions for RES





# RES Program Administration

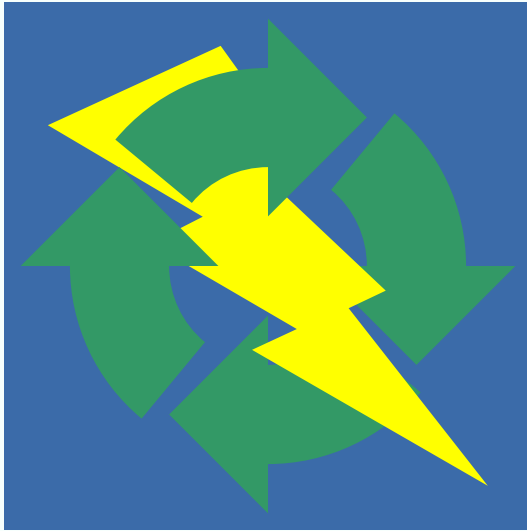
- Plan to maintain as much of RPS program structure as possible
- Continue CEC/CPUC administrative roles where possible
  - Facility certification
  - Compliance monitoring
  - Generation procurement and retail sales verification
  - Reporting activities
- ARB to administer enforcement and penalties



# Draft Regulation Timeline

- Completed draft regulatory language pending completion of staff analyses and unresolved issues:
  - DWR and WAPA
  - Exemption threshold
  - Tradable RECs
  - Interagency administrative roles
- Initial draft late February or early March





# **Questions: RES** **Regulatory Concepts**

Gary Collord

Energy Section

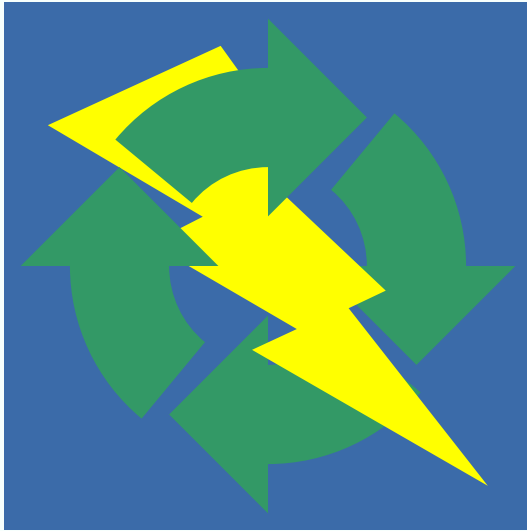
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# Agenda

- ✓ Introductions & Update on Actions since last meeting
- ✓ Summary of Comments on Draft Analyses
- ✓ Update on Technical Feasibility Analysis
  - ✓ GHG Benefits from Eligible Resources
  - ✓ Plausible Compliance Scenarios
- ✓ Update on Economic Analysis
- ✓ Update on Environmental Impact Analysis
- ✓ RES Regulatory Concepts
- **Next Steps**
  - **Mike Tollstrup**





## Questions: Next Steps

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